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The invention conceme a target of cathode sputtering used, like consumable matter in the manufacture of thin layers. The tubular target of form is made of an assembly of plates allowing its correct operation while being compared to the traditional methods of an easy and inexpensive realization.

The technical field is that of the manufacture of deposits in thin layers carried out by the process of cathode sputtering or magnetron. This process is currently well-known and largely widespread in industry, mainly in the field of the electronics of the hard coatings of insulating and different special glasses, decoration, the opto electronics etc

Figure 1 shows a traditional device known under the denomination of double diffusion magnetron. A closed room (1) can be put vacuum by the suitable pumps, for example under a vacuum of 10-6 mB or milli Bars. One introduces into the aforementioned room an inert gas or reagent is for example argon or argon-oxygen mixture or nitrogenizes to amount of a pressure of < RTI ID=1.1> 10-3< /RTI> mB. The target (2) which constitutes the matter to be deposited is fixed on the magnetron (3) in a manner such as the contact with < RTI ID=1.2> celui< /RTI> a good quality of thermal and electric conductivity allows. The magnetron (3) contains magnets (4) and is cooled by a water circulation. The substrate to be covered (5) is presented on the anode (6). When one establishes a strong potential difference electric between cathode and the anode for example 400 volts, the gas ionizes in the space which separates them. The ions strike the target of which they detach from micro the particles which settle on the substrate. According to whether the target is conducting or not, it is used D.C. current with starting high frequency or of the current high frequency says RF.

Figure 2 shows an alternative in which cathode (3) and the target (2) have a tubular form. The principle is the same one. Tubular cathode (3) contains the magnets (4) and is also cooled by water. Anode (6) and substrate (5) are around cathode. In certain machines the substrates turn around cathode, in others cathode toume on itself.

These two forms is the form known as double diffusion and the tubular form is most widespread but there exists about it of different in general derived from these two first. < RTI ID=1.3> II< / RTI> exist conical targets rather derived from tubular, and various forms derived from the targets punts.

The process of cathode sputtering making it possible to deposit very many conducting materials or not of electricity, the methods of manufacture of the targets punts known as double diffusion are varied. Certain metals like the stainless steel, I' aluminium, titanium, the noble metals can be supplied in the form of sheets, of ingots or others and to be machined by traditional means then fixed by screwing, brazing, joining on one laminates or directly on the magnetron. Certain alloys are dissolves preferably vacuum. Many hard or complex alloys are carried out starting from metallurgy powders by pressing followed by sintering, isostatic pressing hot often known pseudonym HIP, by hot pressing and any other known method of the expert. Ceramics and the cermets or metal-ceramics are generally obtained by metallurgy of the powders.

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In the case of the large-sized tubular targets, some target are very expensive to manufacture; others are impossible. If one cannot buy or run directly tubes as it is the case on the one hand for current metals and alloys like steel, Inconel, titanium etc on the one hand and tin for example on the other hand, one is often tiny room to expensive expédients or one cannot use this type of machine however often higher in certain connections and for certain applications. Cathode often consisting of a tube standardized out of stainless steel for example, one deposits material of the target on this tube by various processes which go from plasma to electrolysis. The characteristics are often weak due to a low adherence, an important porosity, a low thickness of known as deposit etc Sometimes, it is possible to make by isostatic pressing hot or HIP, a large block that < RTI ID=2.1> one < /RTI> can drill to make the tube or, which is delicate, to press the powder on a core to save a expensive matter, important times of machining etc

The process according to the invention consists in using a tube traditional cathode as shown by the figure (3). This tube can be for example out of stainless steel or copper or another suitable material. One manufactures and one machines a suitable number of plates of similar material of cathode in dimensions, manufacture and machining with targets of machine known as double diffusion. These plates (2) are machined as figure 4 shows it now in the following way. A face is milled or rectified or sawn to remain punt (1). The opposite face (2) is machined by milling for example in concave form. The radius of curvature being equal to that of the outside of the tube cathode (3). The with dimensions longitudinal ones (4) are machined according to an angle equal to < RTI ID=2.2> 360 " < /RTI> divided by the double of the number of plates that < RTI ID=2.3> one < /RTI> wants to use to make cathode. Two small the with dimensions opposite ones (5) machined according to an average angle for example < RTI ID=2.4> 450.< /RTI> A lower ring shown by the figure (3), part (3) is made according to the following process. Its thickness is the same one or is of the same order which the preceding plate is the thickness of the current target double diffusion of same material. Its internal diameter corresponds to the diameter external of the tube cathode. Its external diameter is such as it corresponds to the envelope of the polygon consisted the plates constitutive of the target as shown by figure 3, part (3). It presents to the top a taper of the same angle than that of the ends of the plates as shown by the figure (3) part (3). The plates target (2) are presented vertically and planted in the lower ring (3) so that their acute part is inserted between the tube cathode and rings. The plates (2) are plated against the tube (1) and a higher ring identical (4) to the lower ring (3) is posed audessus and thanks to its cone fixes say them plates against the tube and immobilizes them. Thus a tubular target starting from any material used for the targets punts is produced known as double diffusion.

< RTI ID=3.1> II< /RTI> exist several alternatives of the process according to the invention. If cathode is used over all its length, the lower ring and the higher ring must be produced in same material as cathode. But it was seen that the rings draw from plates same thickness as the other components < RTI ID=3.2> euxmêmes< /RTI> same thickness as the corresponding target double diffusion. If the material is sufficiently solid to be used in the form of plates but not enough to play the mechanical part of the ring one makes a non-magnetic metal ring traditional stainless steel, copper?

as shown by figure 5. This metal part (1) will maintain the plates and rings out of fragile matter cathode will be brought back over (2) but will not support mechanical efforts. One can use in this case of the similar devices ready to solve says it problem.

< RTI ID=3.3> II< /RTI> often arrive that the means available to the expert to manufacture the plates used for the targets punts or double diffusion, such as forging mill, foundry vacuum or inert gas, isostatic pressing hot or < RTI ID=3.4> HIP, < /RTI> only one limited length allows. This length for much of processes corresponds to the existing means, furnaces, presses, enclosures of isostatic pressing hot etc? This length is often about 1,2 meters. Thus, one can at the same time produce targets double diffusion this length and targets tubular according to the process according to the of the same invention length. For the targets double diffusion bigger length out of difficult materials, one carries out several pieces which one fixes by the means mentioned above, end to end. In the case of a tubular target length surplus the possibilities of manufacture for material of the target one will procédéra in the following way illustrated by figure 6.

The lower ring (1) is laid out as indicated higher. It cast solid or in two parts like is also indicated higher. A first set of plates (2) is applied like previously and is maintained by a baque intermediary (3). This intermediate ring (3) proceeds of the same principle that the lower ring with the difference than it is symmetrical, i.e. than it presents the same taper downwards and upwards. In this manner, when one descends it along the tube, it plates and applies the plates of the first line. At the same time it receives the set of plates higher as previously the lower ring. One in the same way applies the set of plates higher (4) identical in all points to the lower set of plates.

Then one places a higher ring (5) identical in all points to the lower ring and it so cast solid if it is out of the useful part of the target or in two parts if it is likely to be worn.

The rings must be immobilized in translation. The lower ring is advantageously immobilized before the assembly. That can be carried out by any means adapted and well-known of the expert with knowing for example a point of welding, a joining, a screw between leather and flesh, a set of screw in compression? The intermediate ring and the higher ring will be fixed only after complete assembly and tightening of the plates of target against the tube cathode. < RTI ID=4.1> II< /RTI> arrive that the assembly is purely mechanical. In this case, after good application of the plates against the tube obtained while pressing to the bottom the rings intermediary and higher, the same mechanical process will be used in top and bottom.

An interesting alternative is that in which electric and thermal conductivity is ensured by a brazing. < RTI ID=4.2> Celuici< /RTI> moreover improves the mechanical connection. In this case, as shown in the figure 7, the stainless steel tube for example will be prepared for example by sanding then will receive a fine layer of nickel (2) or of copper (3) by projection, cathode sputtering or different. < RTI ID=4.3> II< /RTI> will be then galvanized in a traditional way with an alloy of brazing (4) well-known like indium, indium tin, étainplomb, money? The concave face of the plates cathodes will be treated in the same way. In this way, each face in contact will receive approximately 2 mm of alloy of brazing. The assembly will be done as explained previously.

The assembled unit will be placed in a furnace which will be preferably vacuum.

The furnace will heat the target < RTI ID=4.4> with-dessus< /RTI> melting point of alloy of brazing i.e. generally towards < RTI ID=4.5> 300 " C.< /RTI> With the fusion of alloy of brazing, < RTI ID=4.6> celui< /RTI> will be maintained by capillarity. A pressure exerted by a simple weight (5) or an unspecified device adapted on the higher ring will apply the plates against the tube by the play of the cones of the rings.

Balance between this pressure and the capillarity of liquid brazing will ensure a brazing of quality identical to that used for the targets known as double diffusion.

The advantage of this method is that it makes it possible by simple heating to once separate the tube from the worn targets that-cis and to re-use the tube which did not undergo any deterioration due to the process.

The shape of the target obtained is a cylinder of polygonal section.

If 6 longitudinal plates are used it is a hexagon.

The thickness of the target thus varies approximately 70% between the tops and the mediums of with dimensions of the polygon. As the targets are intended to be worn to the tube support at best and at all in other parts that can not be génant and one can Laisser the target in this form. So on the other hand this report/ratio is too high for a normal operation of the target, one can fall the angles to the turn or in correction and even go until a circular section. Any other method of removal of matter like grinding, electro-erosion? is also possible.

The process according to the invention makes it possible to manufacture targets of cathode sputtering of tubular form at a comparable price and by a method and with equipment comparable with those used for the targets punts or double diffusion. This fact the process according to the invention can be used for all the materials which pose problems of manufacture or cost when they are large-sized tubes. Current dimensions of these tubes given as example can be diameter 130 mm for a 1300 mm length or diameter 200 mm for a length of about 2 meters or even 3,5 meters

or diameter 180 mm for a 2,2 meters length. One can choose like example of advantageous realization of targets of this type by the process according to the invention any hard, fragile, expensive material like tungsten, of many ceramics, the cermets such as chromium, mixed ceramics oxidizes of indium-oxide of tin, or ITO, silicon.

Chromium monoxide of silicon Cr-Sio and many complex alloys.

Like practical example of realization, we will choose a tube chromium plates some but the same method pourait to practically apply without change to a target of ITO. The plates of chromium or ITO are made as for targets punts one double diffusion. Thus let us consider a tube cathode out of austenitic stainless steel 18/8 traditional. Its external diameter is 200 mm and its thickness 5 Misters. Its length is of 2000 Misters. Figure 3. Whereas the simplest method currently used is to cover it with 2 to 3 mm of chromium per electrolysis, the same support cathode out of target double diffusion would support a thickness of chromium of 18 Misters. One will machine by, milling 12 plates of chromium of dimensions 1000 X 137 X 31 mm appears (3) part (2). These chromium plates are traditional in the manufacture of the targets double diffusion. One then machines for example by milling a concave face according to a radius of 202/2 is 101 Misters.

This to take account of the thickness of the brazing which will be used further. The with dimensions longitudinal ones will be also machined in milling with an angle of 30 < RTI ID=6.1> ?. < /RTI> The small with dimensions ones will be machined same manner with an angle of 45 < RTI ID=6.2> ?. Les< /RTI> three rings with knowing the lower ring, the higher ring and the intermediate ring are sorted of another plate with a diameter approximately 250 mm but of the same thickness than the preceding ones used for the plates is 37 Misters. The three rings are made with the turn or in centre hole as higher explained. Their diameters interior and outside, are respectively 202 and 236 Misters.

The assembly is made figure (6) vertically. The lower ring is posed at the end low of the tube and immobilized by screw. The tube on its external surface, the plates on their concave face are galvanized as explained higher. The 6 lower plates are planted between tube and rings then tightened against the tube. The intermediate ring is lowered and blocks say them plates. The 6 higher plates in the same way are presented and one immobilizes them by the means of the higher ring. One transports the whole in driving position in a vacuum brazing furnace. < RTI ID=6.3> Celuici< /RTI> has a group of primary education vacuum capable of a vacuum about < RTI ID=6.4> 10-3.< /RTI> Its temperature is of < RTI ID=6.5> 350 " C.< /RTI>

One applies to the higher ring a weight of 100 KG. After having made the vacuum, one heats with < RTI ID=6.6> 350 " C, < /RTI> one maintains half an hour at this temperature then one operates a cooling controls at a speed compatible with materials of cathode and the target.

To avoid the increase of brazing between the various elements, it is advisable to use one of the many well-known processes of the expert of which more the current consists in sticking a narrow adhesive band high temperature along the joint like that is done for the targets punts in several pieces. < RTI ID=6.7> II< /RTI> appears that the target thus manufactured will be hexagonal; its smaller diameter being of the 236 mm and its largest of approximately 273 mm.

That can not géner operation. In this case, after the traditional operations of completion, the target is finished. If one wants to obtain a target perfectly or partially cylindrical one will pass it to the turn or in correction until obtaining the desired geometry. This operation being similar to the completion of a target double diffusion after brazing.

One will notice that to make in 6 plates, i.e. a hexagon, a tube of diameter external cathode 130 mm and useful thickness of target of 18 mm, one needs plates of section 100 X 28 mm whereas for a tube of diameter external 200 for a useful thickness of 18 mm one needs only 6 plates of section 137 X 31 mm is hardly thicker.

In the preceding examples and figures, one chose a hexagonal assembly whose each stage is made of 6 plates. < RTI ID=7.1> II< /RTI> appears indeed that it is a good compromise giving thicknesses of targets which do not vary too much for a number of plates to manufacture and assemble reduced. However for certain materials and dimensions the number of plates can vary.

One can either use a square for example or even triangular section, or to use more plates, approaching thus more and more the circular section but then the number of joints increases him too.

< RTI ID=7.2> II< /RTI> exist, as one already mentioned, of the tubes bigger length, 3,5 meters for example. In this case, the target will consist of several stages. For a tube of 3,5 m out of chromium for example, it will be advantageous of. to produce the target in 3 stages of 1.150mm each one, blocked by two external rings and two intermediate rings.

< RTI ID=7.3> II< /RTI> exist targets of conical form. In certain cases one can have advantage to carry them out according to the process, according to the invention. The plates will be trapezoidal, their width being reduced with dimensions open cone towards the top of that Ci. The lower ring can < RTI ID=7.4> être< /RTI> then a massive part, the higher ring having a form directly derived from that used for the cylindrical targets.

< RTI ID=7.5> II< /RTI> is necessary to notice that the target produced, according to the process, constitutes a mechanical whole in itself, and does not need the tube cathode to maintain its coherence and its solidity. The carrying tube said tube cathode one is facilté for the sealing, the assembly but is not essential in oneself. One can thus also construct a cathode or another whole in conformity with the invention without carrying tube.

In another alternative it appears that < RTI ID=7.6> one < /RTI> can have interest to do without the rings to block the plates. In this case, the plates can be brought back, either between them, or on the tube support by very proceeded known of the expert. One can mention inter alia the average following. The plates can be brazed on the tube while being maintained by an adequate assembly. They can be stuck with an adhesive conducting, screwed, be embedded in grooves, be fixed by dovetails or any other device adapted to the problem.

From the principle of the cathode sputtering which consists of an ionic bombardment of the target and the deposit on a substrate, the distance between the target and the substrate can be very important 10 cm or more. This property is used in the case of target double diffusion punts. When certain materials of targets cannot be carried out in the form of alloy, of mixtures or of pseudo alloys for reasons physical, practical, of cost or because the result has undesirable characteristics, such as for example a too low melting point, one can use targets made up of < RTI ID=8.1> piêces< /RTI> alternated of two or more component materials. Let us quote for example alternate tungsten plates and silicon and having a surface corresponding to a precise composition used instead of the alloy W Six. Until now this process was excluded from the field of application of the tubular targets.

An alternative of the process according to the invention, thus consists in alternating the plates in several different materials and calculating their angular surface so that the deposit on the substrate has the desired composition. As example take a tungsten plate followed by a plate of silicon and so on. The respective width of the silicon and tungsten plates allowing to carry out on the substrate a deposit of formula W Si2. This process called by sectors is already applied for the targets punts but the process according to the invention makes it possible to use it for the tubular targets, thus opening new applications to them.

Another alternative of the process according to the invention which can bring a facility of manufacture in certain cases of difficult matters of target consists in using a tube support of polygonal cross-section. The plates do not need then more to be machined in concavity. Fixing concerned with the same principle as for the tubes of circular section.